charge, benzene absorbs about two atoms of hydrogen, yielding a polymeride of C_6H_8, a resinous substance with an irritating smell. On heating, benzene first distils over; then a liquid, soluble in strong nitric and sulphuric acid, finally leaving carbon containing a little hydrogen. Oil of turpentine absorbs about 2·5 atoms of hydrogen, yielding resinous products. Pure carbon does not combine with hydrogen under the influence of the discharge, and a mixture of hydrogen with acetylene behaves much in the same way as pure acetylene. A mixture of hydrogen and carbon monoxide yields the solid body observed by Brodie and Thénard, $5CO + 3H_2 = CO_2 + C_4H_6O_3$, a trace of acetylene being formed.

PHOSPHORUS PENTAFLUORIDE.—Professor Thorpe has lately described this body (Liebig, *Ann.* clxxxii.), which he prepares by the gradual addition of phosphorus pentachloride to arsenic trifluoride. Phosphorus pentafluoride is a colourless gas, with a pungent and extremely irritating odour; it reacts upon water, forming phosphoric and hydrofluoric acids. The density with regard to hydrogen was found to be 63·23 (theory requiring 63); under the pressure of twelve atmospheres at 7° it exhibits no marked deviation from Boyle's law; it does not seem to be affected by the passage through it of electric sparks either when pure or when mixed with hydrogen or oxygen. With dry ammonia it forms the compound $2PF_5 5(NH_3)$.

MOLECULAR VOLUMES OF SULPHATES AND SELENATES.—An account of investigations on this subject has lately been published by Otto Petterson (*Deut. chem. Ges. Ber.*, ix. 1559), in which he finds that, in the series of sulphates and selenates of potassium, ammonium, rhubidium, and cæsium the molecular volume of the compound is regularly increased by 6·6 when the group SO_4 is exchanged for the group SeO_4; also, that the substitution of a molecule of ammonium, rubidium, or cæsium for a molecule of potassium produces an increase in volume of 9, 8, and 23 respectively in the selenates as well as in the sulphates. He has also examined the double sulphates and selenates of cobalt, nickel, and copper with potassium, in which results are found tending to confirm the hypothesis that in double salts the components are unaltered; this is more marked in the case of the selenates, in which the volumes of the double salts are equal to the sums of the volumes of their components. The author disagrees with Favre and Valson in their conclusions that double salts cannot exist in solution, and are formed at the moment of crystallisation; he believes on the contrary that as no contraction takes place on crystallisation these salts may be held to exist in the same condition in solution as after crystallisation; the double salt of thallium is, however, an exception. In the case of the alums also when obtained in an anhydrous condition the volume of the salt exactly equals the volumes of its components.

CONTRIBUTIONS TO THE THEORY OF LUMINOUS FLAMES.—A continuation of experiments on the above subject is given by K. Heumann (*Liebig's Ann.*, clxxxiii.), in which he finds that carbonaceous matter will give luminous or non-luminous flames, according as the temperature of the flame is high or low; diluting the gaseous combustible with indifferent gases also requires a higher temperature to cause a separation of the carbon, and thus produce luminosity. Reduction of temperature in a flame prevents either partially or entirely the formation of carbon, consequently the author thinks that the deposition of carbon on cold surfaces in a flame is not the consequence of cooling, as a deposition may be formed on red-hot surfaces, but burns away in contact with air. In burners of different materials, those of iron were found to prevent the luminosity of the lower part of the flame to a greater extent than those of steatite, also when the burner is heated, a greater amount of light is produced, the consumption of the combustible remaining the same. Herr Heumann thinks that by heating the burner the luminosity is increased, and extends to a greater extent over the lower part of the flame.

NOTES

WE are informed that H.M. Government has just been pleased to sanction the necessary expenditure to replace the important deep-soil thermometers of the Royal Observatory, Edinburgh, which were so cruelly broken by a madman last September. The estimate has been prepared by Messrs. Adie and Son, Princes Street, Edinburgh, and is understood to include everything that can conduce to scientific accuracy.

PROF. J. DEWAR, F.R.S.E., Jacksonian Professor of Natural Experimental Philosophy in the University of Cambridge, has been elected Fullerian Professor of Chemistry to the Royal Institution in the room of Dr. Gladstone, resigned.

DR. COLAN, the senior medical officer of the recent Arctic Expedition, has been promoted to be Deputy Inspector-General of Hospitals.

DR. W. B. CARPENTER, C.B., commenced, on Monday evening, at the School of Mines, Jermyn Street, a free course of lectures on geology, which he is delivering as Swiney Professor.

AT the meeting of the French Geographical Society on April 4 it was announced that the great gold medal of the Society had been awarded to Commander Cameron in recognition of his services in the cause of geographical science.

THE estimate for "Education, science, and art in Great Britain amounted in 1853–4 to 578,000*l.*; this year the estimate was 3,546,000*l.*" "In 1835 the Government paid for public education a sum of 26,750*l.*, but in 1875–6 the amount had increased to 3,972,008*l.*"

AMONG the fifty-seven candidates for admission into the Royal Society are two clergymen of the Church of England, one Wesleyan minister, one peer, one foreign baron, one baronet, eleven M.D.s, &c.

THE late Mr. J. C. Tufnell has bequeathed to University College, Gower Street, 5,000*l.* to be used in establishing two scholarships, one in general chemistry and the other in analytical and practical chemistry.

THE Rev. E. Ledger, Gresham Professor of Astronomy, will deliver a course of Lectures on the Telescope, in the theatre of Gresham College, on the evenings of April 17, 18, 19, 20. The electric light will be used to illustrate the lectures.

LIEBIG is to have another monument. A few weeks ago we noted the "inauguration" of one at Darmstædt. Subscriptions are now being collected for the purpose of raising a statue to him in Munich. About 7,000*l.* has already been contributed.

MR. H. W. S. WORSLEY-BENISON, F.L.S., has been appointed Lecturer on Botany at Westminster Hospital.

THE services of Mr. W. Saville Kent, F.L.S., F.Z.S., have been engaged temporarily to superintend and place in thorough order the "Fish House" at the Zoological Society's Gardens, Regent's Park. A considerable number of marine fish and other specimens of interest have been imported to the tanks during the past week.

TWO views have been offered as to the mode of action of the gas in the radiometer. One attributes the motion to reaction of gas particles getting heated on the vanes, then dancing off; the other to air currents which are directed towards the plate in consequence of heated air rising from it. M. Neesen has endeavoured (*Pogg. Ann.*) to decide between these views. If the second view is correct, he argued, the wall of the vessel, by becoming also heated, must also acquire influence through rise of heated air from it as from the vanes. If the rotation be merely a phenomenon of reaction there is no reason to suppose such an influence of the fixed wall. Now by giving the radiometer an eccentric position within the glass vessel such an influence of the walls should be readily recognised. He describes a number of experiments made in this way, and which he regards as supporting the second view.

In an article contributed to *Poggendorff's Annalen*, M. Zollner is led to take the following positions in reference to the radiometer. The explanation of radiometric motions based on the principles of the mechanical theory of gases, makes suppositions about the relation of the mean lengths of path of the gas molecules to the dimensions of the vessel which are not realised in fact. This explanation further leaves out of consideration, without sufficient ground, the simultaneous existence of mercury vapours whose molecules have a more than seven times greater mass and a much smaller mean length of path than the molecules of the gas acting according to the mechanical theory of gases. Hence we are not warranted in regarding the radiometric motions discovered by Crookes as an empirical confirmation of the mechanical theory of gases.

Berlin dealers in delicacies have recently received from the south, and especially from Upper Italy, immense quantities of edible birds which have been captured there in their flight northwards. Unfortunately there were not only snipe, fieldfare, and larks, or so-called "delicacies" among the birds sent, but also singing birds, that are never eaten in Germany, such as goldfinch, thrush, and nightingales. The animals were caught on their migratory flight by means of nets, or surprised during the night and indiscriminately killed. A new indication of the importance of an international law for bird protection!

An exhibition of objects relative to pre-historic archæology will be opened shortly in Moscow, and promises to be very interesting.

An elaborate volume just published by the Federal Statistical Bureau of Switzerland, gives the number of scientific societies in the country in 1875 as 46, with 54,955 members. The societies for educational purposes numbered 816, with 54,424 members.

The municipal authorities of Berne have set aside the sum of 24,000*l.* for the foundation of a Museum of Natural History in that city.

Associations and Committees are being formed in most of the large towns of the Netherlands with the object of "fitting out a suitable vessel for Nova Zembla and other stations of interest in the Arctic regions." The avowed aim of the expedition is not the discovery of the Pole, but the erection of some unpretentious granite monuments to the memory of the glorious discoveries of the earlier Dutch navigators. About the end of the seventeenth century, "in the name and on behalf of the honourable Council of the renowned City of Amsterdam," Willem Barends set out on his third voyage, which ended in the explorer's wintering on Nova Zembla, whence he never returned. It is, above all, the memory of Barends which the Dutch are about to honour. The costs of the expedition are to be defrayed by voluntary subscriptions, and the vessel will, in all probability, be commanded by a Dutch lieutenant who has taken part in three Arctic expeditions under the British flag.

The Committee of the German African Society has issued an appeal for help towards the establishment of a series of permanent stations in Africa, so as gradually to narrow the area of the unknown country, to serve as centres of culture, and to be depots for information and for trade with the natives. The effort would be in sympathy with that of the International Congress at Brussels, and the appeal is made specially to Germany to maintain the exceptionally high place she has taken in the scientific discovery of Central Africa.

Geographical students will be glad to learn that an index to Petermann's *Mittheilungen aus Justus Perthes's geographischer Anstalt über Wichtige neue Erforschungen auf dem Gesammtgebiete der Geographie* has been published for the period between and including the years 1865 to 1874. The value of this is greatly increased by the publication therewith of index maps, which show at a single glance those parts of the world of which maps have been published in the *Mittheilungen* during the period in question, with references to the places where they have appeared.

Gen. Uchatius bases his invention of the steel bronze, or more correctly, hard bronze, cannons, now introduced into the Austrian service, on the observation, that all metals (with exception of lead and zinc) have their elasticity increased, when they have undergone a continuous weighting above their first limit of elasticity. In the first February number of *Dingler's polytechnisches Journal*, M. Uchatius gives, in reply to the objections of some technologists, the results of further experiments, which appear to show that even homogeneous bronze is capable of a great increase of its elasticity through simple stretching, without condensation. It is only a stretching of the metals above their limit of elasticity, whereby the molecules, brought to a state of flow, glide over each other, and assume a wholly new position more favourable to resistance, that causes the increase of elasticity. A simple condensation produces merely an increase of the absolute solidity and diminution of the tenacity, but no real increase of elasticity. The limit of elasticity may be raised nearly to the breaking consistence, so that in many cases it is six and seven times the original. Mere stretching for a short time is of little use; the tension must act a considerable time. It is also well to apply a gradually increasing weight.

A singular fact with reference to the production of heat is described by M. Olivier (*Comptes Rendus*). A square bar of steel 15 mm. in width and 70 to 80 ctm. long is seized with the two hands, placed, one at one end, the other in the middle of the bar. The other end is pressed against an emery grind-stone rotating rapidly. In a few minutes the rubbed end is considerably heated. The band at the middle has no sensation of heat, but that at the extremity is strongly heated, so that it has to be taken from the bar. Thus, in certain cases, heat appears not to be propagated in metals from one part to that next it.

In the year 1824 M. Wöhler made the observation that palladium, whether in the form of sponge or of polished sheet, has the property of becoming sooty in a spirit flame, and gradually coated with a thick layer of carbon. A piece of spongy palladium will thus be enlarged to several times its original volume. The same phenomenon occurs if the metal is made to glow in a coal-gas flame. If the deposited carbon be burnt, there remains always a fine skeleton of palladium, which is then found to be penetrated with the carbon and quite brittle. By more recen experiments M. Wöhler convinced himself that the phenomenon is not due to a special affinity of palladium for carbon. He is rather of opinion that the strong absorption power of this metal for hydrogen is the reason why ethylene gas and the gases of the spirit flame, which themselves are not absorbed by palladium, are decomposed under the influence of this metal, as the experiments show, with separation of carbon.

Led by speculative considerations regarding the formation of the earth, M. Sacher, of Salzburg, made experiments a short time ago on the solidification of balls of spermaceti floating freely in a liquid, and he has more recently experimented on the propagation of heat in unequally dense liquids. In a beaker glass, 16 ctm. high, he put five layers of alcohol varying in density from 0·98 to 0·82, and each 3 ctm. thickness. Three thermometers were placed with their bulbs in the first, third, and fifth layers respectively, and the vessel was slowly heated from below. In another similar vessel containing liquid all of the same density, the three thermometers showed nearly the same temperature;

but in the stratified liquid marked differences appeared between the layers on readings being taken every five minutes. Thus in ten minutes the readings were 31° (below), 18·5° (middle), 18° (top); after twenty minutes, 44°, 19·5°, 18°; after fifty-five minutes, 77°, 40°, 21°. The numbers prove, then, that in liquids of decreasing density heat is distributed very slowly from below upwards. Experiments in cooling led to a similar result.

PROF. QUINCKE, of Heidelberg, has long experimented as to whether gases can penetrate through the pores of glass. A pressure of forty to one hundred and twenty atmospheres is found to be incapable of forcing a perceptible quantity of carbonic acid or hydrogen gas through a glass wall 1·5 mm. thickness, during a period of seventeen years. No loss of weight was perceptible. M. Quincke, however, will not draw the inference that the molecules of hydrogen and carbonic acid have larger dimensions than the molecules or pores of the glass. The distance at which the molecular forces of the glass act on the gas-particles is of course greater than the dimensions of the molecules themselves. The pore walls of the glass may get coated with an "absorbed" gas layer, which itself becomes immovable through the nearness of the solid substance, and hinders the passage of gas particles from the interior of the glass tube into the outer air. Perhaps, too, there may be dropable liquid in the pores of the glass, preventing outflow of the gas. A similar objection applies (according to M. Quincke) to M. Traube's method of determining the size of the molecules of a substance from the possibility of passing through a so-called "precipitate-membrane."

A DROUGHT in excess of any that have occurred during the last fourteen years, as regards long continuance and severity, has prevailed for some months in Victoria and parts of Australia adjoining. It terminated about February 12, and from that date to the 22nd of the same month, when the mail left, heavy thunderstorms and rainfall had prevailed, and cooler weather set in. The reports from Deniliquin and other places in the interior state that not a blade of grass was to be seen on the plains, and cattle were dying in thousands.

THE Russian Naval Department proposes to send a ship this summer to the mouths of the Obi and Jenissei to make a thorough maritime survey of both gulfs.

THE *Western Review of Science and Industry* is the title of a new monthly devoted to various departments of science, and published in Kansas City, Mo.

IN view of the promising future of the African continent M. Bernardin, of Ghent, has done a good service by publishing a *brochure* (compiled from the works of various travellers), on the commercial products of Central Africa. An excellent map of Petermann's, showing the standpoint reached by exploration up to September, 1876, is included in the pamphlet.

THE death is announced of Prof. P. Panceri, the eminent Italian anatomist. He died suddenly whilst lecturing in the University at Naples.

THE additions to the Zoological Society's Gardens during the past week include a Common Wolf (*Canis lupus*) European, presented by Mr. J. A. Parlet; a Ceylon Fish Owl (*Ketupa ceylonensis*) from Ceylon, presented by Capt. B. B. Turner; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Mr. W. Bazeley; two Sykes's Hemipodes (*Turnix sykesii*), a Rain Quail (*Coturnix coromandelica*), an Asiatic Quail (*Perdicula asiatica*) from India, three Chinese Quails (*Coturnix chinensis*) from China, presented by Mrs. Wood Mason; an Entellus Monkey (*Semnopithecus entellus*) from India, received in exchange; a Collared Fruit Bat (*Cynonycteris collaris*) born in the Gardens.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 5.—Prof. Odling, F.R.S., in the chair.—A lecture on the discrimination of crystals by their optical characters was delivered by Prof. N. S. Maskelyne, F.R.S. After a few general remarks on the use, to the chemist, of the methods employed by crystallographers, the lecturer proceeded to consider the methods of determining the symmetry of crystals by their optical characters. The origin and meaning of various terms used in crystallography were explained and illustrated by models, &c.; the lecturer then threw on the screen, by means of a polarising apparatus and the electric light, the beautiful coloured effects produced by crystals of cerussite, barytes, borax, &c., the effect of heat in altering the position of the optical axes of a crystal of gypsum being especially beautiful. In conclusion, the lecturer pointed out the ready means, which the examination of the optical characters of a crystal under the polarising microscope often afforded to the chemist, of acquiring a great deal of information in a very short time, and expressed a belief, that if chemists would work up suitable groups of crystals for examination by the crystallographer, very important knowledge as to the functions of various groups of molecules in a crystal would be gained.

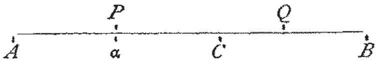
Anthropological Institute, March 27.—Col. A. Lane Fox, F.R.S., V.P., in the chair.—Capt. W. Samuells, of the Bengal Staff Corps, was elected a member.—An account of some Kitchen Middens near Ventnor, by Mr. Hodder M. Westropp was read by the director. A corn-crusher, of Scandinavian appearance, was found in one of them, and in another higher up in the cliff, there was discovered a small cinerary urn of unusual shape encircled with a pattern of coralline sea-weed.—Messrs. W. Power and E. Laws communicated a short paper on a Kitchen Midden near Tenby; Dr. Crockley Clapham a paper on the brain-weights of the Chinese and Pelew Islanders; and Mr. James Shaw some notes on right-handedness and improved instinct in animals during the human period. Dr. Clapham found that the weight of the brain both of the Chinese and the Islanders was above the average, but they presented certain peculiarities in their convolutions. The skulls of the Pelew Islanders were markedly dolichocephalic. The size of the brain of the Chinese and the Islanders was in no wise an index of the intelligence possessed by them.

MANCHESTER

Literary and Philosophical Society, February 6.—E. W. Binney, F.R.S., president, in the chair.—Notice of the Junior Literary and Philosophical Society of Manchester, 1806-1807, by W. E. A. Axon, M.R.S.L.—On compound combinations, by Prof. Cayley, F.R.S., &c.—On ternary differential equations, by Robert Rawson.—On the powerful oxidising action of animal charcoal upon organic matters as shown by the analysis of the drainage from a large heap of a mixture of night-soil and animal charcoal, by William Thomson, F.R.S. Edin.—A plea for the word "Anglo-Saxon," by Rooke Pennington, LL.B., F.G.S.

CAMBRIDGE

Philosophical Society, March 12.—Prof. Cayley, vice-president, in the chair.—Prof. Clerk Maxwell communicated to the Society a paradox in the theory of attraction.



Let the line AB be divided in any given point C, and let

$$PC^{-1} - AC^{-1} = CQ^{-1} - CB^{-1}$$

be the condition of correspondence of two points P and Q, in the segments AC, CB respectively, then if P and Q vary simultaneously, still remaining correspondent,

$$PC^{-2}d(PC) = CQ^{-2}d(CQ),$$

or the corresponding elements are to each other as the squares of their distances from C. If we now suppose that AB is a material line of uniform density, the law of attraction being the inverse square of the distance, the attractions of corresponding elements on the point C will be equal and opposite. But every element of AC has a corresponding element in CB, and hence we might conclude that the attraction of AC on C is equal and opposite to that of CB on C, which is evidently not the case, unless $AC = CB$. The paradox is explained by considering that all that we have proved is that the attraction of AP on C is equal and opposite to that of QB on C, and this however near to C the